Correlation analysis for various morphological traits of *Chenopodium album, Amaranthus viridis, Anagallis arvensis and Asphodelus tenuifolius*

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Abstract: The weeds are undesirable plant grown in the crop fields. The removal of weeds from crop field is much important to minimize yield loss of crop plants. A study was conducted to access the relationship among weed plant traits during March 2015 at Centre of Excellence in Molecular Biology, University of the Punjab Lahore, Pakistan. It was found that higher plant population of *Anagallis arvensis*, *Asphodelus tenuifolius* and *Chenopodium album* was recorded for most of studied locations. *Asphodelus tenuifolius* showed higher total plant and inflorescence moisture percentage. It was found that total plant moisture percentage and total inflorescence moisture percentage was strongly and significantly correlated with each other. It was suggested from correlation of plant population and total plant and inflorescence moisture percentage that the weed plants used much of the input sources of crop plants. The competition of crop plant with weeds increased due to higher weed population and adversely effects water and nutrient requirements. It was suggested that the herbicide resistant varieties should be developed of use herbicide before sowing of crop plants.

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1. Introduction

Weeds are the plants out of place where it is not grown. It is also called pest plant. Common weeds are very fast growing and resilient that competes with cultivated crop. They are a source of pest and diseases. Best way to control them is to prevent it from being established as its removal is time consuming. Weeds also give shelter to various insect pests & disease pathogens and they may serve as alternate hosts for spread of pest and disease (Qamar *et al*., 2015; Harrem *et al*., 2015; Sadia *et al*., 2015; Mobeen *et al*., 2015; Qurat-ul-Ain *et al*., 2015; Saira *et al*., 2015 and Saeed *et al*., 2015).

1.1. *Chenopodium album* (Bathu)

Chenopodium album is a fast growing weedy annual plant. It belongs to family Chenopodiaceae.It commonly called as lamb's quarters, melde, goose foot and fat-hen. It grows and utilize extensively in Northen India as a food crop.*Chinopodium album* origin is Eastern Asia. Soil which rich in nitrogen this weed arises almost all over and mostly in wasteland. This weed have the tendency to raise straight at first, attain a height of 10-15 cm (hardly to 3m), but generally flat after flowering (because of density of the foliage and seeds) without supported by other plant. Its leaves are alternate and can be different in appearance. *Chenopodium album* first leaves arise near from the bottom of the plant, are pointed and approximately diamond-shaped, 3-7 cm tall and 3-6 cm wide. The leaves on the upper part of the flowering stems are full and lanceolate-rhomboid, 1-5 cm tall and 0.4-2 cm wide; they are waxy-coated, unwettable and mealy in occurrence, with a whitish coat on the underneath. Its flowering time is June to September (Brenan 1981; Burkill 1985 and Burkill 2000).

1.2. *Amaranthus viridis* (Jangli chulai)

Amaranthus viridis is very common garden weed. This weed found in footpaths, roadsides and riparian flora. It belongs to family Amaranthaceae. It commonly called, green amaranth, green pigweed, slender amaranth. *Amaranthus viridis probably* of Asian origin, but now a cultivated weed in the tropical and subtropical areas of the world. In tropical Africa it is also an extensive and familiar weed. An annual herbaceous plant with an upright or decumbent nature. It generally attains a height of 40-100cm tall; but it attains a height of 1.5m.Its stem delicate, branched, pointed, and hairless to thin pubescent in upper part consisting of many hairs.

Leaves of this weed are alternate, simple; stalk up to 10 cm tall; blade trigonal-elliptic to rhomboid-rectangular, 2–8 cm × 1.5–6 cm, base proximately three-sided, notched tip with small apex, edges sometimes crawl, hairless to pubescent.Inflorescence consisting of compiled cymes organized in delicate, mainly terminal spikes, recurrently paniculate, up to 12 cm long, in the bottom part of the stem usually in heavy axillary bundle, 7 mm in diameter. *Amaranthus viridis* flowers are unisexual. This weed gives flowers year around. Its fruit capsules are rumpled, indehiscent (not open to release seed when mature), small in size and brown in color. Its fruit have smooth and silky seeds (Townsend 1988; Costea *et al*., 2001).

1.3. *Anagallis arvensis* (Billi Boti)

Anagallis arvensis also called as red chickweed, poor man's weather-glass, shepherd's clock, red pimpernel. It is a low-growing annual plant. It grows on the roadside, dry sandy edges and in waste place. The species native to Europe, Western and North Africa. *Anagallis arvensis* belongs to family Primulaceae. This weed Scarlet pimpernel has weak straggle stems maturing to about 50 cm (20in.) tall, which carry bright green oblong sessile leaves in different pairs. It has creeping, square stem. The small orange, red or blue flowers are build in the leaf axils from spring to autumn. The petal edges are considerably scalloped and have small glandular hairs. Blue-flowered plants are common in some areas, such as the Mediterranean region. When the sun shines only then scarlet pimpernel flowers are open. *Anagallis arvensis* flower bloom in May as far as late into August (Manns and Anderberg 2007).

1.4. *Asphodelus tenuifolius* (Onionweed)

A. tenuifolius is an arrect annual, monocotyledonous herb; basis bare in adolescent plants and aphotic amber at maturity, apparently has the actualization of the taproot arrangement of dicotyledons, a harder and compacted array of tape roots, which may sometimes aberration to accord a rope-like appearance; leaves numerous, all basal, hollow, slender, gradually acicular to a point, 10 to 40 cm long, the abject sheathing, bland to carefully hairy; appearing to as a 'bunch' from the soil, scapes several, simple, dispersed angled aberration in high region, stout, 3 mm in diameter, up to 60 cm long; flowers campanulate, white with blush or purple stripe, in lax racemes; bracteate, pedicellate, shorten axis may be jointed; petals 1.5 cm continued in six perianth segments; stamens six; simple, superior, 3-carpelled, 3-loculed ovary; beginning advanced advancement in the bloom over a aeon of weeks, commonly flowers do not accessible until backward afternoon and unless altitude are addled and air-conditioned will abutting and atrophy afore the next day; fruit, a 3-valved annular capsule, dehiscing at partitions into the cavity, beyond wrinkled, about 3 mm long; seeds 3-angled, blackish, cautiously pebbled texture, abysmal aberrant dents on face and back (Yadav *et al*. 1995; Sekhon *et al*. 1993; Lazarides *et al*. 1997 and Malik and Singh 1994).

2. Materials and Methods

The present study was conducted at Centre of Excellence in Molecular Biology, University of the Punjab Lahore, Pakistan during March 2015. The of *Carthamus oxycantha, Cirsium arvense, Cleome viscose and Convolvulus arvensis* weeds was collected from 4 different locations *viz*. Centre of Excellence in Molecular Biology, University of the Punjab Lahore, Institute of Agricultural Sciences (IAGS), University of the Punjab Lahore, Hanjerwal colony near Centre of Excellence in Molecular Biology, University of the Punjab Lahore and Road side area of Ferozepur Road Kasur. The data was recorded for fresh plant weight, fresh inflorescence weight, dry plant weight, dry inflorescence weight by using an electronic balance (OHAUS-GT4000, USA), total plant moisture percentage [(fresh plant weight – dry plant weight)/fresh plant weight*100], total inflorescence moisture percentage [(fresh inflorescence weight - dry inflorescence weight)/ fresh inflorescence weight*100] and number of plants per square meter area. The data was statistically analyzed by using analysis of variance technique (Steel *et al*., 1997).

3. Results and discussions

It was revealed from table 1 that significant differences were reported for all studied traits. Significant interactions were also recorded for weeds×locations. It was found that average dry plant weight for all locations was 6.3838±0.5632g while fresh plant weight was found as 36.954±3.9022g. There was a significant difference between fresh and dry weed plant weight. As total plant moisture percentage 82.193±2.0011% was also higher that revealed the facts about water contents in the weed plant body. The higher plant moisture percentage indicated that the weed plants absorbed much higher moisture from soil that caused competition of crop plants with weeds for water absorption and nutrients availability. The dry inflorescence weight was 2.6125±0.0126g which showed higher difference for fresh inflorescence weight (10.359±0.7872g). The inflorescence moisture percentage (72.972±3.0922%) which was low as compared with plant moisture percentage showed that the weeds plant store much of the water contents in their plant body to survive in harsh, hot and dry conditions. It was found that average number of plants per square meter or weed

plant population was 63.701±2.0971. The higher weed plant population suggested that the competition of weed plant with crop plants will be higher. The weed plants also offer a cover place or place to live or hide for insects (Sabbir *et al*., 2014). The weeds should be controlled to minimize the harmful effects of weeds for crop plants (Qamar *et al*., 2015; Harrem *et al*., 2015; Sadia *et al*., 2015; Mobeen *et al*., 2015; Qurat-ul-Ain *et al*., 2015; Saira *et al*., 2015 and Saeed *et al*., 2015).

Table 1. ANOVA for various morphological traits of weeds

Source of variation	DF	Dry plant weight	Inflorescence Dry weight	Fresh plant weight	Inflorescence Fresh weight	No of plants/m^2	Total plant moisture percentage	Total inflorescence moisture percentage
Replications	2	0.2592	0.2592	0.2592	0.2592	0.2592	0.2594	0.25898
Weeds	3	22.0041*	1.9105*	885.363*	23.2472*	2241.12*	37.4168*	469.552*
Location	3	216.836*	38.3831*	3569.62*	789.232*	1173.82*	814.904*	122.774*
Weeds×Location	9	41.8483*	0.67403*	632.282*	13.3169*	394.193*	337.902*	106.015*
Error	15	2.37E-31	9.70E-32	5.58E-30	7.84E-31	1.15E-29	4.50E-08	3.95E-08
Grand Mean		6.3838	2.6125	36.954	10.359	63.701	82.193	72.972
Standard Error		0.5632	0.0126	3.9022	0.7872	2.0971	2.0011	3.0922

* = Significant at 5% probability level

It was revealed from results given in table 2 that significant differences were found among all the weeds for all studied traits. It was found that higher plant population of *Anagallis arvensis* was recorded at CEMB (90.12) and Hanjerwal colony (71.19), *Asphodelus tenuifolius* at Institute of Agricultural Sciences (IAGS), University of the Punjab Lahore, and *Chenopodium album* at Kasur (72.89) while lowest weed plant population was reported for *Amaranthus viridis* at CEMB (47.12), Hanjerwal (25.34), Punjab University (56.67) and *Anagallis arvensis* at Kasur (57.89). The higher plant population indicated that the weeds provide shelter for insects (Sabbir *et al*., 2014). It was revealed from results that that higher fresh weed plant weight of *Amaranthus viridis* was recorded at CEMB (81.11g) and 87.890g at Institute of Agricultural Sciences, University of the Punjab Lahore, at Hanjerwal colony (45.320g) and Kasur (52.230g) for *Asphodelus tenuifolius*. The highest weed plant dry weight was recorded for *Amaranthus viridis* at CEMB (23.320g), Hanjerwal (15.230g) and Punjab University (12.430g) and *Chenopodium album* at Kasur (7.540g) while lowest fresh and dry weed plant weight was reported for *Anagallis arvensis* at CEMB (13.200g, 1.230g), Hanjerwal (15.200g, 1.090g), Punjab University (11.210g, 1.230g) and at Kasur (11.230g, 1.220g) respectively. It was revealed from results that that higher inflorescence fresh and dry weight of *Asphodelus tenuifolius* was recorded at CEMB (20.32g, 5.04g), (32.23g, 4.67g) at Punjab University, at Hanjerwal colony (23.23g, 6.35g) and Kasur (24.32g, 7.03g) respectively. The lowest inflorescence fresh and dry weight was recorded for *Anagallis arvensis* (3.12g, 1.02g) at CEMB, Hanjerwal (4.34g, 1.09g) at Punjab University (5.34g, 1.02g) and *Chenopodium album* at Kasur (3.25g, 1.02g) respectively. The higher plant and inflorescence weight indicated that the accumulation of organic compounds in the weed plant and inflorescence parts was much higher to develop essential body parts and normal body functions. It was revealed from results that that higher total plant and inflorescence moisture percentage of *Asphodelus tenuifolius* was recorded at CEMB (93.708%, 75.197%), (90.351%, 85.510%) at Punjab University respectively, higher total plant moisture percentage of *Anagallis arvensis* at Hanjerwal colony (92.829%) and Kasur (89.136%) and higher total inflorescence moisture percentage of *Chenopodium album* at Hanjerwal (78.482%) and Kasur (76.602%. The lowest total plant and inflorescence moisture percentage was recorded for *Amaranthus viridis* (71.249%, 62.500%) at CEMB, Hanjerwal (46.146%, 74.885%) at Punjab University (85.857%, 80.899%) respectively while *Chenopodium album* at Kasur (59.641%) and *Anagallis arvensis* (45.626%) lowest total plant and inflorescence moisture percentage respectively. The higher moisture in the plant and inflorescence parts of the weed plant body suggested that the weeds used much of the soil water and nutrients due to which the competition of the crop plants with weed plants caused yield losses. The weed population should be controlled to reduce the harmful effects of weeds. The weeds provide shelter to various insects that also attack crop plant and caused the crop plant yield reduction. The herbicide (glyphosate) resistant crop varieties should be produced the improve crop plant yield (Sabbir *et al*., 2014; Qamar *et al*., 2015; Harrem *et al*., 2015; Sadia *et al*., 2015; Mobeen *et al*., 2015; Qurat-ul-Ain *et al*., 2015; Saira *et al*., 2015 and Saeed *et al*., 2015).

Table 2. Mean performance of weeds for various morphological traits at different locations

No of plants/m^2					
Weeds/Locations	**CEMB**	**Hanjerwal Colony**	**Punjab University (IAGS)**	**Kasur**	**Average**
Chenopodium album	52.13c	28.67c	82.65c	72.89a	59.085c
Amaranthus viridis	47.12d	25.34d	56.67d	67.78c	49.227d
Anagallis arvensis	90.12a	71.19a	89.56b	57.89d	77.19a
Asphodelus tenuifolius	65.34b	40.67b	98.89a	70.87b	68.9425b
Average	63.6775c	41.4675d	81.9425a	67.357b	
Fresh plant weight (g)					
Weeds/Locations	**CEMB**	**Hanjerwal Colony**	**Punjab University (IAGS)**	**Kasur**	**Average**
Chenopodium album	28.680c	34.310b	20.690c	18.670c	25.588c
Amaranthus viridis	81.110a	28.280c	87.890a	19.23b	54.127b
Anagallis arvensis	13.200d	15.200d	11.210d	11.230d	12.710d
Asphodelus tenuifolius	67.230b	45.320a	55.340b	52.230a	55.030a
Average	47.555a	30.778c	43.783b	25.34d	
Inflorescence Fresh weight (g)					
Weeds/Locations	**CEMB**	**Hanjerwal Colony**	**Punjab University (IAGS)**	**Kasur**	**Average**
Chenopodium album	3.21c	5.23c	6.34b	3.25d	4.5075c
Amaranthus viridis	6.24b	8.35b	5.67c	8.89b	7.28.75b
Anagallis arvensis	3.12c	4.34d	5.34d	4.23c	4.2575d
Asphodelus tenuifolius	20.32a	23.23a	32.23a	24.32a	25.025a
Average	8.2225d	10.2875b	12.395a	10.1725c	
Dry plant weight (g)					
Weeds/Locations	**CEMB**	**Hanjerwal Colony**	**Punjab University (IAGS)**	**Kasur**	**Average**
Chenopodium album	5.340b	3.120c	6.340b	7.540a	5.585b
Amaranthus viridis	23.320a	15.230a	12.430a	3.23c	13.553a
Anagallis arvensis	1.230d	1.090d	1.230d	1.220d	1.193d
Asphodelus tenuifolius	4.230c	3.470b	5.340c	6.340b	4.845c
Average	8.530b	5.728d	6.335b	4.583d	
Inflorescence dry weight (g)					
Weeds/Locations	**CEMB**	**Hanjerwal Colony**	**Punjab University (IAGS)**	**Kasur**	**Average**
Chenopodium album	1.01c	1.23c	1.11b	1.02d	1.0925d
Amaranthus viridis	2.34b	2.03b	1.02c	2.08c	1.8675b
Anagallis arvensis	1.02c	1.09d	1.02c	2.3b	1.3575c
Asphodelus tenuifolius	5.04a	6.35a	4.67a	7.03a	5.7725a
Average	2.3525d	2.675c	1.955b	3.1075a	
Total plant moisture percentage (%)					
Weeds/Locations	**CEMB**	**Hanjerwal Colony**	**Punjab University (IAGS)**	**Kasur**	**Average**
Chenopodium album	81.381c	90.906b	69.357d	59.614d	75.315c
Amaranthus viridis	71.249d	46.146c	85.857c	81.203c	71.614d
Anagallis arvensis	90.682b	92.829a	89.028b	89.136a	90.419b
Asphodelus tenuifolius	93.708a	92.343ab	90.351a	87.861b	91.066a
Average	84.255a	80.556c	83.648b	79.954d	
Total inflorescence moisture percentage (%)					
Weeds/Locations	**CEMB**	**Hanjerwal Colony**	**Punjab University (IAGS)**	**Kasur**	**Average**
Chenopodium album	68.536b	76.482a	82.492b	68.615c	74.031bc
Amaranthus viridis	62.500d	75.689b	82.011bc	76.603a	74.201bc
Anagallis arvensis	67.308c	74.885c	80.899c	45.626d	67.179c
Asphodelus tenuifolius	75.197a	72.665d	85.510a	71.094b	76.116a
Average	68.385c	74.930b	82.728a	65.485d	

Table 3. Pooled correction among various morphological traits of weeds

Traits	Dry plant weight	Inflorescence Dry weight	Fresh plant weight	Inflorescence Fresh weight	No of plants/m^2	Total plant moisture percentage
Inflorescence Dry weight	0.8686*					
P<0.05	0.0305					
Fresh plant weight	0.6246*	0.4135*				
P<0.05	0.0001	0.0187				
Inflorescence Fresh weight	-0.0608	0.8977*	0.4312*			
P<0.05	0.7412	0.0000	0.0137			
No of plants/m^2	0.4078*	-0.0168	0.8234*	0.186		
P<0.05	0.0205	0.9274	0.219	0.3081		
Total plant moisture percentage	0.6246*	0.3011	0.9941*	0.3027*	0.3071*	
P<0.05	0.0001	0.094	0.6084	0.0922	0.0873	
Total inflorescence moisture percentage	0.9005*	0.0123	0.1999	0.3177*	0.2465*	0.9678*
P<0.05	0.0231	0.9468	0.2726	0.0764	0.1738	0.0074

It was persuaded from the results of correlation analysis among different studied traits of weeds that there was a significant correlation of dry plant weight with inflorescence dry weight, fresh plant weight plant population, total plant moisture percentage and total inflorescence moisture percentage. Inflorescence dry weight was significantly correlated with dry plant weight, fresh plant weight and inflorescence fresh weight. There was a significant correlation between fresh plant weight and dry plant weight, plant population, inflorescence dry and fresh weight and total plant moisture percentage. Inflorescence fresh weight was significantly correlated with inflorescence dry weight, fresh plant weight, total plant and inflorescence moisture percentage. Plant population was significantly correlated with dry and fresh plant weight, total plant and inflorescence moisture percentage. It was found that total plant moisture percentage and total inflorescence moisture percentage was strongly and significantly correlated with each other. It was suggested from correlation of plant population and total plant and inflorescence moisture percentage that the weed plants used much of the input sources of crop plants. The competition of crop plant with weeds increased due to higher weed population and adversely effects water and nutrient requirements. It was suggested that the herbicide resistant varieties should be developed of use herbicide before sowing of crop plants. The positive correlations also suggested that the weeds have higher growth rate and water use efficiency as compared with crop plants (Elahi *et al*., 2014ab; Ali *et al*., 2014abc; Ali *et al*., 2013; Harrem *et al*., 2015; Sadia *et al*., 2015; Mobeen *et al*., 2015; Qurat-ul-Ain *et al*., 2015; Saira *et al*., 2015 and Saeed *et al*., 2015).

Conclusions

It was concluded from all of the above study that the weeds should be controlled through chemical, manual of through the use of transgenic crop plants to minimize the yield loss due to weeds.

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